

Potential Commercial Application of Bio-carbon from Biomass of Ontario

#### CCRA/CanmetENERGY R&D Program on Biocarbon for Steel Production

September 1, 2020

CanmetENERGY Leadership in ecoInnovation









# **Program Funding**

- Canadian Carbonization Research Association (CCRA) ۲
- Office of Energy Research and Development, Natural **Resources Canada**

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017





#### About CCRA

- Formed in 1965 to conduct research on behalf of Canada's steel and metallurgical coal producers for the competitive advantage of the industry.
- 8 corporate members include Canada's ۲ major steel companies, coal mining companies, pyrometallurgical companies and government member



© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017





# **CCRA GHG Research**

Gradual decrease in carbon intensity, and embrace new fossil fuel free reductants as industry transitions to carbon neutrality to produce "green" steel.

#### **R&D Strategy for Stepwise Transition:**

- (2020) Development of GHG reduction solutions in current processes: Blast furnace carbon efficiency enhancement
- (2020-2025) Near future implementation: Substitution of fossil carbon by renewable biocarbon in blast furnace ironmaking
- (2020-2050) Long term R&D: Carbon neutral ironmaking technology

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017









Natural Resources Ressources naturelles Canada Canada





Natural Resources Ressources naturelles Canada Canada

# **Program Objectives**

- To identify suitable raw biomass feedstock
- To develop pyrolysis technology for converting feedstock in suitable bio-carbon for cokemaking and ironmaking
- To develop technologies for enabling utilization of biocarbon in cokemaking and ironmaking

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017





# **Raw Biomass Supply**

- Feedstock Location, Quality and Quantity Evaluation
  - Forestry Residues
  - Construction and Demolition (C&D) wood
  - Rail ties and decommissioned pole
- Feedstock Physico-Chemical Properties Database

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017





#### Suitable Bio-carbon Production

- Pyrolysis Technology Development
  - Technology Benchmarking
  - Pre-Treatment of feedstock by steam explosion
  - HTC Process
  - Pyrolysis of C&D wood and rail ties

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017





#### Suitable Bio-carbon Production

- **Pyrolysis Product Properties Beneficiation** •
  - Densification using pyrolysis oil binder
  - Biocarbon pellet/briquette quality determination standards
  - Technology for ash content control

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017





# **Ash Content Control**

- P, Na and K are detrimental to blast furnace ironmaking
- Control by limiting input
- Content of these 3 elements in biocarbon is usually higher than coal
- Substitution of coal by bio-carbon leads to increase in input
- Need to develop technology for removing these 3 elements in biocarbon



© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017





## **Biocarbon Utilization**

- Bio-carbon for Direct Injection
  - Value-in-use evaluation
  - Grindability of bio-carbon
  - Pulverized bio-carbon combustion behavior
- Bio-carbon for Cokemaking
  - Technology for forming bio-carbon/coal briquette
  - Effect of bio-carbon in coal blend on resultant coke quality
- Industrial Scale Plant Trials

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017



## **Bio-Carbon VIU**

- Assumed carbon tax: \$50/tCO<sub>2</sub>
- VIU of bio-carbon depends on chemical composition
- Use of bio-carbon with low C content leads to increase in production even with carbon tax taken into consideration
- VIU increases as C content in bio-carbon • increase



© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017





## **Next Step**

- Pilot scale cokemaking test (2020)
- Pyrolysis of rail ties (2020)
- Bio-carbon injection plant trail in AM Dofasco (2021)

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017



